DOCUMENT RESUME

ED 246 807 HE 017 555

AUTHOR	Makowski, David; Wulfsberg, Rolf M.
TITLE	An Improved Taxonomy of Postsecondary Institutions. Working Paper Series.
INSTITUTION	National Center for Higher Education Management Systems, Boulder, Colo.
SPONS AGENCY	National Inst. of Education (ED), Washington, DC. Educational Policy and Organization Program.
PUB DATE	82
CONTRACT	400-80-0109
NOTE	52p.; Report presented as part of the HEGIS Data Quality Project. For related documents, see HE 017 556-558.
AVAILABLE FROM	National Center for Higher Education Management Systems, P.O. Drawer P, Boulder, CO 80302 ($3.00).
PUB TYPE	Reference Materials - Vocabularies/Classifications/Dictionaries (134) -- Reports - Descriptive (141)
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	Bachelors Degrees; *Classification; *Colleges; Comparative Analysis; *Degrees (Academic); Doctoral Degrees; *Institutional Characteristics; Intellectual Disciplines; *Postsecondary Education; Professional Education; Two Year Colleges
IDENTIFIERS	HEGIS Data Quality Project

ABSTRACT

The taxonomy of postsecondary-education institutions that was developed by the National Center for Higher Education Management Systems (NCHEMS) is described and compared to taxonomies developed by the National Center for Education Statistics (NCES) and the Carnegie Commission on Higher Education. Criteria used to classify higher education institutions are identified: the number of degrees earned by type of degree, the number of fields in which degrees were earned, and the ratio of degree completions in several specific fields to total degree completions. Five major categories of institutions are classified as follows: major doctoral-granting institutions, comprehensive institutions, general baccalaureate institutions, professional and specialized institutions, and two-year institutions. Subcategories within each of these areas are also described. In comparing taxonomies developed by NCES, NCHEMS, and the Carnegie Commission, 20 data items were examined, including degrees awarded by level, number of programs by level, full-time-equivalent enrollment by level, total full-time enrollment, total full-time faculty, and expenditures by category. The relative performance of the different taxonomies for various sample sizes is also assessed. (SW)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED246807

An Improved Taxonomy of Postsecondary Institutions

Working Paper Series

HE 017 555

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

NCHEMS

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

National Center for Higher Education Management Systems

Working Paper Series

Working papers can cover a broad range of subjects and treat them at various depths. Primarily, they represent progress reports or initial investigations—a literature survey that we would like to share with others, for example, or a description of and rationale for a new concept on which we would like the research community to comment.

Additional copies of this and similar documents prepared in the course of research, development, and service projects at NCHEMS may be obtained at the prevailing cost of duplication and distribution. Because this is a working paper, individuals wishing to quote or reproduce it, in whole or in part, are asked to secure permission from NCHEMS. For a list of titles and current prices, write:

NCHEMS Publications
P.O. Drawer P
Boulder, Colorado 80302

An Improved Taxonomy of Postsecondary Institutions

David Makowski
Rolf M. Wulfsberg
1982

HEGIS Data Quality Project

National Center for Higher Education Management Systems
P.O. Drawer P Boulder, Colorado 80302
An Affirmative Action/Equal Opportunity Employer

The work upon which this publication is based was performed by NCHEMS pursuant to Contract No. 400-80-0109--Program on Educational Policy and Organization--with the National Institute of Education. It does not necessarily reflect, however, the views of that agency.

Foreword

This report is one of four written as part of the project called Assessing the Quality of the HEGIS Data. The project was supported by the National Institute of Education and was designed to study problems and issues related to the quality of the data collected through the Higher Education General Information Survey (HEGIS) by the National Center for Education Statistics (NCES). Data are annually collected from all colleges and universities in the United States. There are five major surveys collected annually, and three minor surveys collected periodically. The major surveys are entitled Institutional Characteristics, Financial Statistics, Opening Fall Enrollment, Earned Degrees, and Employees. The periodic surveys are entitled Facilities, Residency and Migration, and Libraries.

Frequently HEGIS data are needed to make comparisons between states, between institutions, and between institutional sectors. Since higher education is so diverse, comparative analysis is often difficult. After reviewing previous work done in the area, this project examined HEGIS data for their comparability, policy relevance, accuracy, and validity. To examine comparability, four studies were conducted through the Data Quality project: (1) the development of a new and improved taxonomy for colleges and universities; (2) a study investigating the impact of medical schools on the financial statistics reported by institutions; (3) a survey of state practices affecting the reporting of HEGIS data; and (4) an assessment of longitudinal changes in the reporting units of the HEGIS universe. To examine policy relevance, the project studied the utility of the data from a researcher's perspective. To examine accuracy and validity, the project conducted a study that suggested NCES could improve the accuracy of the data by more extensive verification checks identifying outlying institutions through cross-survey measures.

Four reports are being made available to any interested party; they are listed below by title and author.

- "An Improved Taxonomy of Postsecondary Institutions" by David J. Makowski and Rolf M. Wulfsberg
- "Impact of Health Programs on Instructional Expenditures in Higher Education" by John D. Smith
- "State Reporting Practices and the Quality of HEGIS Finance Data" by Jane N. Ryland
- "The Utility of HEGIS Finance Data: A Researcher's Perspective" by Marilyn McCoy

Copies of the papers can be obtained by writing to:

Data Quality Project
NCHEMS
P.O. Drawer P
Boulder, Colorado 80302

Introduction

There is a continuing need to be able to summarize and compare information about postsecondary-education institutions. With several thousand such institutions in existence, it is imperative that they be grouped in a systematic way that permits data about postsecondary education to be summarized. Furthermore, there is a need for a uniform system by which researchers and analysts can add the results of any particular study to the overall understanding of postsecondary education for the use of future researchers.

Historical Background

One of the largest publishers of postsecondary-education data is the National Center for Education Statistics (NCES), an agency of the U.S. Department of Health, Education and Welfare. For the purposes of publishing summary data, NCES has historically classified institutions into three categories: universities, other four-year institutions, and two-year institutions. In addition, for each category, separate summary statistics are published for public and private institutions. While this system has the benefit of being consistently very simple and relatively stable, it has tended to obscure major differences among institutions. Furthermore, there are no objective criteria for placing an institution into one of the categories.

The Carnegie Commission on Higher Education early recognized that for analytical purposes, a better classification of institutions was needed. In 1970, the Commission developed its own classification scheme that was subsequently used in much of its analytical work. In a technical report the Commission described the categories and identified institutions by these categories (1973). In 1976 the Commission updated the classification using 1973-74 data and published a revised edition of the classification. Although the Carnegie taxonomy provides a comprehensive, definitive classification of institutions, it has four major problems: (1) it is difficult to update because of its complexity; (2) it utilizes a number of diverse data sources; (3) it uses subjective judgments in classifying institutions; and (4) it uses nineteen categories in its taxonomy causing problems in publishing summary data.

In 1974, recognizing deficiencies in the Carnegie and NCES classification schemes, a subcommittee of the Federal Interagency Committee on Education (FICE) began work on a new classification system for Federal statistical publications and other Federal agency use. This new classification emphasized instruction levels in institutions instead of program areas or program size. While the basic approach met with general approval, the scheme was criticized for its failure to account for program areas and size, for not having mutually exclusive and clearly defined categories, and for not having categories that could be easily merged into popularly used groups.

Performance Criteria

Hoping to develop an improved taxonomy that would improve on the earlier systems, the National Center for Higher Education Management Systems (NCHEMS) initiated a review of the subject in 1977. The first step was to define criteria

that a uniform institutional classification system should meet. These criteria are listed below.

- The classification scheme should be designed to encompass the full range of postsecondary-education institutions (postsecondary education institutions are defined as those organizations having the provision of postsecondary education as their primary mission).

- The categories for classifying institutions should be complete and mutually exclusive.

- The criteria for assigning institutions to categories should be objective--that is, there should be a set of criteria that consistently and uniquely identified the category to which an institution would be assigned. This set of criteria should be capable of being applied so that regardless of who used the criteria, any given institution would be consistently categorized the same.

- The classification scheme should categorize institutions into homogeneous groupings--that is, when used as a stratification design for sampling purposes, the scheme should produce a design that would be highly efficient statistically.

- The categories should have meaning to the typical user by being descriptive and communicative. The categories should be as well conceptually simple--their meaning intrinsically clear and easily understood.

- The classification scheme should serve as a common basis for publication of data at the state and national levels. There should be sufficiently few categories to make the summarization of data feasible. The possibility of more detailed subcategories within major categories would be made available for use as necessary.

- The classification scheme should provide relative stability over a period of years in the assignment of institutions to categories to provide for analyses of trends.

- The classification scheme should be as compatible as possible with the current NCES scheme in order to provide some continuity to facilitate trend analysis. This provision was included only as long as all other criteria were satisfied.

Structure and Performance of the Proposed Taxonomy

The types of programs offered and the number of students participating in those programs were selected as the basis for classifying institutions. This basis for classification met the criteria of being descriptive and communicative since many institutions consider these two factors as being determinants of peer institutions. In addition, these factors are objective in that each can be quantified.

Because comprehensive data on program offerings of institutions and the number of students enrolled in those programs are not readily available, degree completion data were used as a surrogate measure. Such data are collected annually by NCES through the Survey of Earned Degrees and Other Awards Conferred, part of the Higher Education General Information Survey (HEGIS). The survey of earned degrees gathers the number of degree completions by program area as defined in the HEGIS Taxonomy of Programs (Huff and Chandler 1970) and type of degree (first-professional, doctorate, masters, baccalaureate, associate, and other two-year awards). While completion data are reported at the four-digit level of the HEGIS Taxonomy, these data were aggregated to the two-digit level so that only major fields of study were considered.

The actual numerical criteria used to classify institutions of higher education were of three types:

- The number of degrees earned by type of degree (doctorate, master's, etc.). This measure provides an indication of an institution's commitment to the levels of education offered (postbaccalaureate, undergraduate).

- The number of fields in which degrees were earned. This measure is an indication of diversity in program offerings at institutions.

- The ratio of degree completions in several specific fields to total degree completions. This is an indication of program emphasis at an institution.

Using these numerical measures in a manner described later, five major categories were defined. Within these categories, subcategories were defined that further distinguished important characteristics. The categories and subcategories that resulted are described below.

A. Major Doctoral-Granting Institutions

These institutions are characterized by a significant level of activity in and commitment to doctoral-level education as measured by the number of doctorate recipients and the diversity in doctorate program offerings. Included in this category are those institutions that are not considered specialized schools (see D below) and that grant a minimum of 30 doctoral-level degrees. These degrees must be granted in three or more doctoral-level program areas[1] or, alternatively, have an inter-disciplinary program at the doctorate level. Included in the counts of doctorate degrees are the first professional (M.D., D.V.M., O.D., and D.D.S.) degrees.

A-1. Major Research Institutions

These institutions are significantly engaged in research activities as measured by the amount of expenditures for research purposes. These institutions are the leading 75 institutions in

[1]Programs or program areas are a major field of study as defined at the two-digit level of the HEGIS Taxonomy of Programs. Subsequent references to program or program area refer to this definition.

research expenditures. (This measure is derived from the annual HEGIS Financial Statistics Survey.)

A-2. Other Major Doctoral Institutions

These institutions, while perhaps still involved in research activities, are not as significantly involved as the Major Research Institutions. These institutions include all other major doctoral institutions.

B. Comprehensive Institutions

These institutions are characterized by a strong, diverse postbaccalaureate program (including first professional), but do not engage in significant doctoral-level education. Specifically, this category includes institutions not considered specialized schools in that the number of doctoral-level degrees granted is less than 30 or in that fewer than three doctoral-level programs are offered. In addition, these institutions must grant a minimum of 30 postbaccalaureate degrees[2] and either grant degrees in three or more postbaccalaureate programs, or alternatively, have an interdisciplinary program at the postbaccalaureate level.

C. General Baccalaureate Institutions

These institutions have, as their primary emphasis, general undergraduate, baccalaureate education. They are not significantly engaged in postbaccalaureate education. Included are institutions not considered specialized institutions in which the number of postbaccalaureate degrees granted is less than 30 or in which fewer than three postbaccalaureate level programs are offered, but either (a) grant baccalaureate degrees and grant degrees in three or more baccalaureate programs, or (b) offer a baccalaureate program in interdisciplinary studies. Additionally, over 25 percent of the degrees granted must be at the baccalaureate level or above.

D. Professional and Specialized Institutions

These are baccalaureate or postbaccalaureate institutions that are characterized by a programmatic emphasis in one area, usually a professional field such as business or engineering. The programmatic emphasis is measured by the percentage of degrees granted in one program area. An institution granting over 60 percent of its degrees in one field, or granting over half of its degrees in one field and granting degrees in fewer than five baccalaureate programs is considered to be a professional or specialized institution.

D-1. Divinity Institutions

Institutions in which either the number of professional theological degrees plus the number of other degrees granted in theology (2300 field in the HEGIS Taxonomy) exceeds 60 percent of

---

2Includes master's, doctorate, and first-professional degrees.

all degrees awarded or, alternatively, the number of such degrees awarded exceeds 50 percent of all degrees awarded and the number of baccalaureate programs offered is fewer than five are considered divinity institutions.

D-2. Medical Institutions

Institutions in which health science education is the primary objective and which confer first-professional medical degrees such as M.D., D.O., D.D.S., and D.V.M. constitute medical institutions. These institutions are those (a) in which the number of professional health science degrees (medicine, dentistry, optometry, pharmacy, etc.) granted plus the number of other health science degrees (1200 field in the HEGIS Taxonomy) exceeds 60 percent of all degrees awarded, or, alternatively, the number of such degrees awarded exceeds 50 percent of all degrees awarded and the number of baccalaureate programs offered is fewer than five, and (b) in which one of the following first-professional medical degrees is conferred: M.D., D.D.S., D.O., or D.V.M.

D-3. Other Health Institutions

Institutions in which health science is the primary objective but that do not confer an M.D., D.D.S., D.O., or D.V.M. are referred to as other health institutions. These institutions are those that satisfy criterion (a) above, but do not award any one of the following first-professional medical degrees: M.D., D.D.S., D.O., or D.V.M.

D-4. Engineering Schools

Institutions in which either the number of degrees awarded in the area of engineering (0900 field in the HEGIS Taxonomy) exceeds 60 percent of all degrees awarded, or, alternatively, the number of such degrees awarded exceeds 50 percent of all degrees awarded and the number of baccalaureate programs offered in fewer than five are designated as engineering schools.

D-5. Business and Management Schools

Institutions in which over 60 percent of their degrees are conferred in the area of business and management science (0500 field in the HEGIS Taxonomy), or, alternatively, the number of such degrees awarded exceeds 50 percent of all degrees awarded and the number of baccalaureate programs offered is fewer than five are considered business and management schools.

D-6. Art, Music, and Design Schools

Institutions in which over 60 percent of their degrees are conferred in the area of art, music, and/or design (1000 field in the HEGIS Taxonomy), or, alternatively, the number of such degrees awarded exceeds 50 percent of all degrees awarded and the number of baccalaureate programs offered is fewer than five are referred to as art, music, and design schools.

D-7. Law Schools

Institutions in which either the number of professional law degrees (L.L.B. or J.D.) plus the number of other degrees awarded in law (1400 field in the HEGIS Taxonomy) exceeds 60 percent of all degrees awarded, or, alternatively, the number of such degrees awarded exceeds 50 percent of all degrees awarded and the number of baccalaureate programs offered is fewer than five are designated law schools.

D-8. Education Schools

Institutions in which over 60 percent of their degrees are conferred in education (0800 field in the HEGIS Taxonomy), or, alternatively, the number of such degrees awarded exceeds 50 percent of all degrees awarded and the number of baccalaureate programs offered is fewer than five are considered education schools.

D-9. Other Specialized or Professional Schools

Institutions in which degrees are conferred in <u>fewer than three programs</u> at the baccalaureate level, master's level, and the doctorate level, and that did <u>not</u> confer over 50 percent of their degrees in any of the above categories are designated other specialized or professional schools.

D-0. U.S. Service Schools

Schools under Federal control are referred to as U.S. service schools.

E. Two-Year Institutions

These are institutions in which fewer than 25 percent of their degrees are conferred at the baccalaureate or postbaccalaureate level, and that confer over 75 percent of their degrees or awards for two years of work, or formal awards and completions requiring less than two years of work are considered two-year institutions. Institutions with a two-year upper division program would <u>not</u> fall in this category because they grant baccalaureate degrees. These institutions can be further classified by their program emphasis in either occupational areas or general academic preparation.

E-1. Comprehensive Two-Year Institutions

Institutions in which the number of degrees awarded in occupational and vocational areas is greater than 20 percent but less than 80 percent of all degrees awarded are classed as comprehensive two-year institutions.

E-2. Academic Two-Year Institutions

Institutions in which the number of degrees awarded in the academic area (5600 field in the HEGIS Taxonomy) is at least 80 percent of all degrees awarded are designated as academic two-year institutions.

E-3. Multiprogram Occupational Two-Year Institutions

Institutions in which degrees or awards in two or more occupational programs are conferred and that grant less than 20 percent of their degrees in the academic area (5600 field in the HEGIS Taxonomy) are considered multiprogram occupational two-year institutions.

A pictoral representation of how an institution's category is determined demonstrates the schematic nature of the proposed classification scheme. Such a representation is shown in figure 2 at the end of this paper.

To facilitate longitudinal or trend analysis, the classification scheme should minimize the number of institutions that change categories from year to year. The classification scheme presented in this paper places an institution into a category based on that institution's program characteristics for a given year. Some institutions, because their program characteristics place them on the borderline between two categories, will tend to change categories each year. Other institutions will change categories because of significant shifts in their program characteristics, such as increased enrollments or new program offerings. For an institution in the former case, a classification procedure should assign a category to the institution and require that it remain in that category until it exhibits a significant shift in its program characteristics. And, on the other hand, a classifying scheme should recognize institutions in the latter case and assign them to a new category. Such a strategy would keep institutions from fluctuating between categories while at the same time allowing institutions to move into a new category when they exhibit a sufficient change in program characteristics.

An easy and effective way to recognize significant shifts is to monitor the categories assigned to an institution from year to year. When an institution has been placed in a new category for two consecutive years by the computation scheme, it will be assigned to the new category. For example, a change from category B to category A would occur under the following conditions:

	1975	1976	1977
computed categories:	B	A	A
assigned categories:	B	B	A

The first row refers to the category assigned by the one-year computational scheme. The second row refers to the category that would be assigned by the multiyear assignment procedure. In this case, the numerical data placed the institution in the Comprehensive category in 1975 and the Major Doctoral category in 1976 and 1977. Under the proposed classification scheme, the institution would be assigned to the Comprehensive category in 1975 and 1976, and then, because it was placed in the Major Doctoral category for two consecutive years, it would be assigned this category in 1977. This two-step procedure assures some stability down through the years.

To estimate the extent to which institutions would change categories from year to year using this classification strategy, actual data were examined for the years 1974-1977. Using only the five major categories (A through E) rather than all of the subcategories, 106 institutions had computed categories that changed between 1976 and 1977.

When the assignment procedure was applied, only 55 institutions changed assigned categories. Of these institutions, 80 to 85 percent clearly appeared to be institutions with significant program shifts. The other 15 percent to 20 percent were institutions that were undergoing minor shifts in program characteristics and that could conceivably revert back to their previous, designated category.

After final assignment, 76 institutions differed between their computed category and their final, assigned categories for 1977. These institutions either were beginning to show a significant program shift or else were on the borderline between two classes. Preliminary analysis indicates that most of these institutions (85 percent) appear to be undergoing a shift in program emphasis. (This was determined by examining the computed categories for these institutions for the previous three years and identifying those institutions that are changing category for the first time--implying that a significant program shift is underway.)

Table 1 shows the numbers of institutions changing assigned categories between 1976 and 1977. Most of the 21 shifts occurred from General Baccalaureate (category C) to Comprehensive (category B), accounting for 38 percent of the total. And, in fact, 49 percent of the institutions changing assigned categories moved into the Comprehensive category (a total of 27). Twenty-five (or 45 percent) of the institutions moved from General Baccalaureate to other categories, primarily to Comprehensive. Typical institutions of this type are baccalaureate schools offering new postbaccalaureate programs. Table 2 shows numbers of institutions whose assigned category differs from their computed categories for 1977. Most noteworthy are the Comprehensive/Baccalaureate difference (with a total of 14) and the Baccalaureate/Specialized difference (totaling 18). The former is at least partially explained by the increasing trend in baccalaureate colleges offering new postbaccalaureate programs. The latter suggests that a number of specialized schools are broadening their program offerings. In fact, specialized schools represent the largest difference (a total of 31), accounting for 41 percent of the differences between assigned and computed categories.

Table 1

Institutions Changing Assigned Categories Between 1976 and 1977

Category Assigned in 1976	Category Assigned in 1977					
	A	B	C	D	E	Total
A	-	2	0	0	0	2
B	1	-	3	2	0	6
C	0	21	-	4	0	25
D	1	4	3	-	3	11
E	0	0	6	5	-	11
Total	2	27	12	11	3	55

Table 2

Institutions with Different Computed and Assigned Categories in 1977

Category Computed in 1977	Category Assigned in 1977					
	A	B	C	D	E	Total
A	-	5	0	1	0	6
B	2	-	14	9	0	25
C	0	6	-	18	3	27
D	1	3	6	-	4	14
E	0	0	1	3	-	4
Total	3	14	21	31	7	76

A more conservative alternative procedure would be to require an institution to remain in a new category for <u>three</u> consecutive years rather than two. After analysis, this policy would appear to provide more relative stability (only 25 institutions changed assigned categories between 1976 and 1977 as opposed to 55). However, there are more institutions differing between their assigned category and their computed category (125 vs. 76). Although offering more stability, it would appear to be somewhat less useful for cross-sectional analysis, since quite a few institutions change program characteristics quite drastically in a two-year period, suggesting no need for a conservative approach. The less conservative approach was chosen since only a small number of institutions do change categories and the resulting cross-sectional analysis is more reflective of actual institutional characteristics.

Comparison of the Proposed Scheme to the NCES and Carnegie Taxonomies

It has been shown that the proposed classification scheme meets all of the desireble criteria except for that of forming homogeneous groupings. While the categories defined under the proposed scheme appear to be intuitively homogeneous, the true test lies in an investigation of the variation within

groups for various data items. If, in fact, other classification structures (such as the Carnegie or NCES classifications) form groups that are significantly more homogeneous, the importance of the proposed scheme must be seriously questioned. Above all else, the most important purpose of a taxonomy for analytical purposes is to categorize units into homogeneous groups.

One way to evaluate the extent to which the various taxonomies produce homogeneous groupings is to compare the efficiency of each when each is used as a sampling stratification device. For example, one might suppose that a stratified random sample of size n was drawn from each of the taxonomies, where the strata are identical to the groups formed by the various classification schemes. The sampling variance for given data items could then be calculated for each taxonomy, and the taxonomy that produced the smallest sampling variance would be the taxonomy that produced the most homogeneous groups.

Most specifically, suppose that there are N institutions of higher education, and that the classification scheme being investigated classifies Nh institutions into group h, where there are L total groups. Then N1 + N2 + . . . + NL = N. For the data item being examined, let Sh represent the variance of the item in stratum (group) h. Then for a sample of size n, the sampling variance is minimized if the sample size for each group is nh, where nh is given by

$$n_h = n N_h S_h / \sum_h N_h S_h .$$

This is called the optimum or Neyman allocation of the sample. William G. Cochran in his Sampling Techniques (1963) gives an excellent discussion of sample allocation in stratified random sampling. Using this allocation, the sampling variance, V, is given by

$$V = [(\sum_h w_h s_h)^2 / n] - [\sum_h w_h s_h^2 / N],$$

where $w_h = N_h / N$.

For the data item being examined, the relative efficiency (also called relative precision) of taxonomy i to taxonomy j is given by

$$E_{ij} = (V_j / V_i) \times 100 .$$

Thus, if E_{ij} is greater than 100, taxonomy i is superior to (more efficient and precise than) taxonomy j. Conversely, if E_{ij} is less than 100, the reverse is true.

Six taxonomies were chosen to compare the relative efficiencies of the NCES, Carnegie, and the proposed (NCHEMS) classification systems. The categories of the taxonomies are shown in figure 1. In both the NCHEMS and the Carnegie structures, categories can be easily grouped together to form aggregate categories. From the 17 individual categories of the NCHEMS system, the categories were collapsed into taxonomies with 6 categories and 9 categories. Similarly, the 19 categories in the Carnegie system were collapsed into 6 and 9 categories.[3] The NCHEMS 6-category structure and the Carnegie 6-category

[3]There are many ways in which the categories can be collapsed. The ones chosen seem to be reasonable and common ways to collapse the structures.

structure are quite similar. The 9-category structures differ significantly in that the NCHEMS structure separates two-year institutions into 3 additional categories while the Carnegie structure separated the Comprehensive and Liberal Arts categories into 4 additional categories.

Control	NCES (3)	NCHEMS (6)	Carnegie (6)
1. Public	1. University	1. Major Doctoral	1. Doctoral
2. Private	2. Other Four-Year	2. Comprehensive	2. Comprehensive
	3. Two-Year	3. General Baccalaureate	3. Liberal Arts
		4. Two-Year	4. Two-Year
		5. Medical	5. Medical
		6. Other Specialized	6. Specialized

NCHEMS (9)	Carnegie (9)
1. Major Research Institutions	1. Doctoral I and II
2. Other Major Doctoral Institutions	2. Doctoral III and IV
3. Comprehensive	3. Comprehensive I
4. General Baccalaureate	4. Comprehensive II
5. Two-Year Academic	5. Liberal Arts I
6. Two-Year Vocational	6. Liberal Arts II
7. Two-Year Comprehensive	7. Two-Year
8. Medical	8. Medical
9. Other Specialized	9. Other Specialized

Fig. 1: Description of Categories for Various Taxonomies

Because most analysis of institutional data separates public and private schools, the categories in each of the NCES, NCHEMS, and Carnegie taxonomies were further split by control of institution, resulting in 3 x 2, 6 x 2, and 9 x 2 structures. Table 3, table 4, and table 5 compare the NCHEMS 6-category structure with the NCES structure, the NCHEMS 6-category structure with Carnegie 6-category structure, and the NCHEMS 9-category structure with the Carnegie 9-category structure, respectively.

Because the calculation of relative efficiency depends on the data item being examined (as well as the sample size n), 20 different data items were examined. The variables selected were:

1. Total degrees awarded
2. Total vocational degrees awarded (two-year or less)
3. Total two-year degrees awarded
4. Number of baccalaureate programs
5. Total baccalaureate degrees awarded
6. Total education degrees awarded (baccalaureate and above)
7. Number of postbaccalaureate programs
8. Total postbaccalaureate degrees awarded
9. Total baccalaureate degrees as a percent of total degrees awarded

6. Total education degrees awarded (baccalaureate and above)
7. Number of postbaccalaureate programs
8. Total postbaccalaureate degrees awarded
9. Total baccalaureate degrees as a percent of total degrees awarded
10. Total full-time equivalent (FTE) enrollment
11. Total undergraduate FTE enrollment
12. Total graduate FTE enrollment
13. Total undergraduate FTE enrollment and a percent of total FTE enrollment
14. Total full-time enrollment
15. Total full-time faculty
16. Total students to total faculty ratio
17. Total expenditures
18. Total expenditures for instruction
19. Total expenditures for research
20. Total expenditures per FTE enrollment

These data items were selected for several reasons. First, the above list represents many of the statistics that are most commonly cited and that will be published using the taxonomy that is ultimately adopted by NCES. It is therefore natural that the taxonomy selected should be particularly efficient with respect to those items. Second, one or more of the items on the list should serve as a good proxy for other items of interest that are not on the list when estimating sampling variances. Finally, the list offers a wide variety of data items, thereby assuring that the taxonomies are evaluated against different types of data.

Another factor that effects sampling variances is the size of the sample. To be equitable to all taxonomies being evaluated, the same sample size must be used for each. In addition, the relative efficiency (precision) should be calculated for various sample sizes to check for reversals. For the purposes of this study, sample sizes of 100, 250, 500, and 1,000 were used. These correspond to approximate sampling fractions of 3, 8, 16, and 31 percent, respectively.

A final consideration is the hierarchical level of the taxonomies being compared. A taxonomy evaluated at a low level (that is, many groups) of the hierarchy will always be at least as efficient as the same taxonomy evaluated at a higher level (that is, fewer groups). Hence, it is only reasonable to compare the taxonomies using levels that produce similar numbers of groups. For this reason, the NCES 3 x 2 taxonomy,[4] the NCHEMS 6 x 2 taxonomy, the Carnegie 6 x 2 taxonomy, and the NCHEMS and Carnegie 9 x 2 taxonomies were compared.

---

[4]NCES has a 6 x 2 taxonomy, but it is virtually identical to the NCES 3 x 2 taxonomy. Since the latter classification is the one traditionally used in NCES publications, the 3 x 2 taxonomy was used for NCES.

Table 3

Comparison of NCHEMS 6-Category Structure with NCES 3-Category Structure

NCHEMS	NCES		
	University	Other Four-Year	Two-Year
Major Doctoral	135	34	0
Comprehensive	26	363	0
General Baccalaureate	0	741	1
Two-Year	0	18	1138
Medical	0	52	0
Specialized	0	555	4

NOTE: Table entries represent number of institutions in each cell.

Table 4

Comparison of NCHEMS 6-Category Structure with Carnegie 6-Category Structure

NCHEMS	Carnegie					
	Doct.	Compr.	L. Arts	2-Yr.	Med.	Spec.
Major Doctoral	166	0	1	0	0	2
Comprehensive	15	325	35	0	0	14
General Baccalaureate	0	239	485	1	0	17
Two-Year	0	0	12	1138	0	6
Medical	0	0	0	0	51	1
Specialized	2	31	48	4	0	474

NOTE: Table entries represent number of institutions in each cell.

Table 5: Comparison of NCHEMS 9-Category Structure
with Carnegie 9-Category Structure

NCHEMS (9)	Research	Doct.	Comp. I	Comp. II	Lib. Art I	Lib. Art II	2-Year	Med.	Spec.
Major Research	70	5	0	3	0	0	0	0	0
Other Doctoral	27	64	0	0	1	0	0	0	2
Comprehensive	0	15	274	51	12	23	0	0	14
General Baccalaureate	0	0	95	144	110	375	1	0	17
2-Year Academic	0	0	0	0	0	6	144	0	2
2-Year Vocational	0	0	0	0	0	1	322	0	2
2-Year Comprehensive	0	0	0	0	0	3	672	0	2
Medical	0	0	0	0	0	0	0	91	1
Specialized	0	2	10	21	0	48	4	0	474

NOTE: Table entries represent number of institutions in each cell.

The actual sampling variances that resulted are shown in tables 1-20 at the end of this paper, corresponding to the twenty variables listed earlier. The first column (labelled "Univ") represents the variance that would result if simple random sampling (that is, no stratification) were used. The second column (labelled "Control") shows the variances that would result if the institutions were stratified solely on control (public or private). The remaining column headings are self-explanatory.

Since the effect of larger sample sizes is to reduce the sampling variances for all of the taxonomies, it is perhaps more useful to examine the relative efficiencies instead. Selective relative efficiencies for the variable "total degrees awarded" are shown in table 6. It is evident that the NCHEMS 6 x 2 classification is far superior to the NCES 3 x 2 scheme and that the superiority increases with larger samples. The NCHEMS 6 x 2 classification is also superior to the Carnegie 6 x 2 scheme--a difference that appears to be quite uniform over varying sample sizes. Interestingly, when the two taxonomies are expanded to 9 x 2 structures, there is virtually no difference in the precision each produces.

Table 6

Relative Efficiencies* for Variable 1
(Total Degrees Awarded)

Sample Size	NCHEMS 6 x 2 vs. NCES 3 x 2	NCHEMS 6 x 2 vs. CARN 6 x 2	NCHEMS 9 x 2 vs. CARN 9 x 2
100	134	110	101
250	136	110	101
500	140	110	101
1000	151	108	100

$$* \; Eij = \frac{(Vj}{Vi)} \times 100$$

The relative efficiencies for all twenty variables for a sample size of 500 are shown in table 7. The proposed 6 x 2 taxonomy was superior to the NCES classification in all 20 cases and was superior to the Carnegie 6 x 2 classification in 16 cases. When the 9 x 2 classifications were compared, the NCHEMS taxonomy was superior in only 7 of the cases. (It should be noted that the term superior is being used in a strictly ordinal sense; it does not necessarily connote a statistically significant difference.)

Table 7

Relative Efficiencies for a Sample Size of 500

Variable Number	NCHEMS 6x2 vs. NCES 3x2	NCHEMS 6x2 vs. CARN 6x2	NCHEMS 9x2 vs. CARN 9x2
1	140	110	101
2	111	104	118
3	107	101	107
4	259	78	77
5	176	99	83
6	186	106	98
7	344	225	187
8	240	169	135
9	198	116	113
10	132	104	96
11	130	103	98
12	232	138	110
13	180	100	99
14	134	105	96
15	140	109	95
16	111	96	99
17	186	110	88
18	157	114	93
19	1173	101	86
20	252	76	75

The relative performance of the NCHEMS and Carnegie classifications for various sample sizes (table 8) suggests that the NCHEMS 6 x 2 taxonomy is clearly superior to its counterpart. Interestingly, however, as the sample size increases, the superiority somewhat diminishes. This suggests that the NCHEMS taxonomy tends to segregate a large part of the overall variance into a small number of relatively small groups, while the Carnegie classification focuses the variance into somewhat larger groups that take longer to deplete or reduce through sampling.

Table 8

Summary of the Relative Efficiency of Selected Taxonomies

Sample Size	NCHEMS 6 x 2	Carnegie 6 x 2	NCHEMS 9 x 2	Carnegie 9 x 2
100	17	3	9	11
250	17	3	8	12
500	16	4	7	13
1000	14	5	6	14

NOTE: Table entries represent the number of variables for which the specified taxonomy was superior to the other taxonomy. For a sample size of 1,000, there was one tie at the 6 x 2 level.

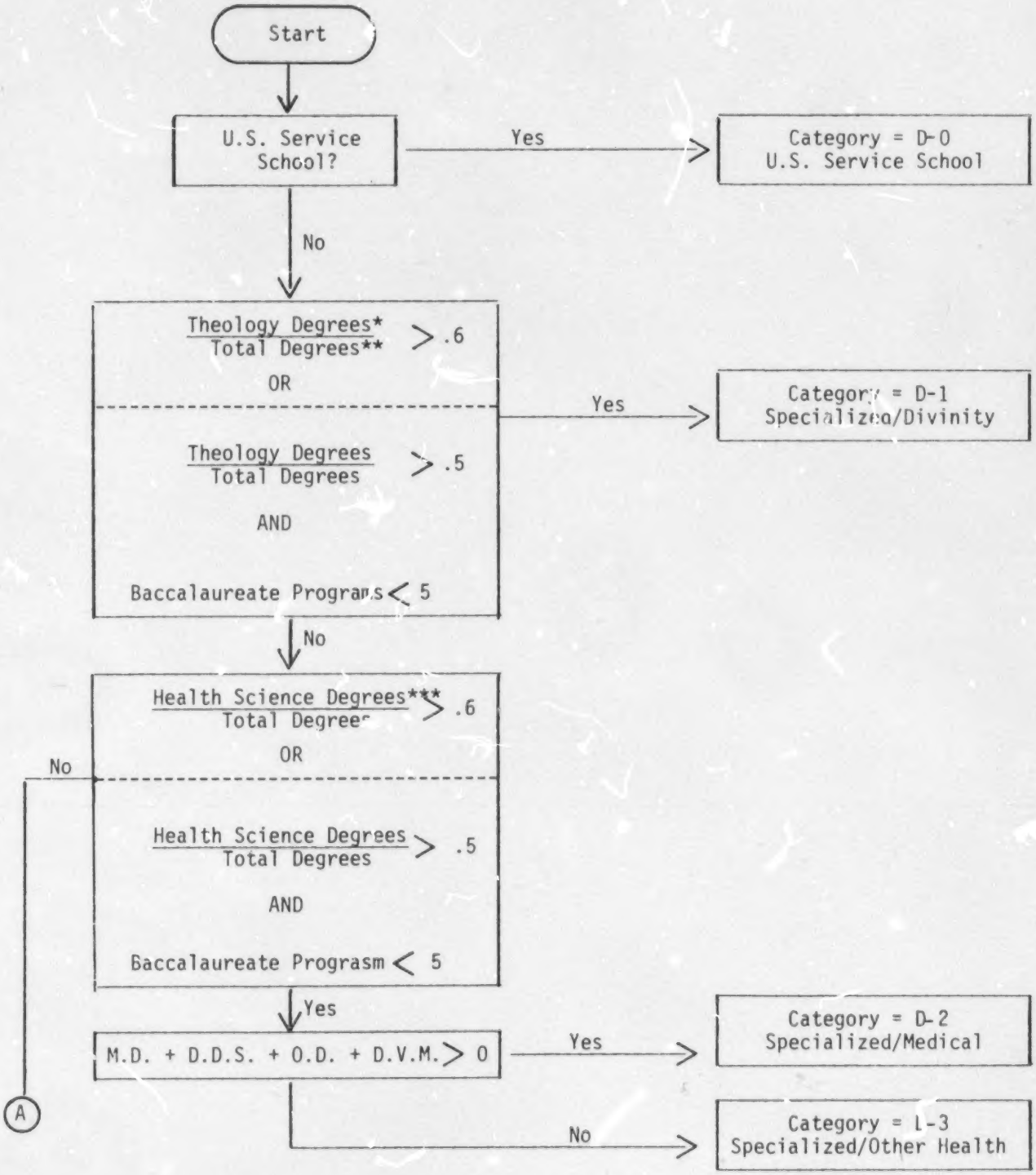
At the 9 x 2 level of classification, the Carnegie taxonomy was superior to the proposed taxonomy. Again, the Carnegie classification improved relative to the NCHEMS taxonomy with larger samples. The Carnegie superiority at the 9 x 2 level suggests that, for most variables, greater marginal efficiency can be gained by further partitioning the comprehensive and liberal arts four-year institutions than by further partitioning the two-year institutions.

Conclusions

The results of the study demonstrate that both the NCHEMS and Carnegie classifications represent significant improvements over the current NCES 3 x 2 taxonomy with respect to the definition of homogeneous categories. At the 6 x 2 level of classification, the NCHEMS taxonomy appears to be slightly more efficient than the Carnegie classification for most variables, and the former is considerably easier to update. Accepting the criteria presented in this paper as valid performance standards for a taxonomy, requires accepting the conclusion that the NCHEMS 6 x 2 classification is superior overall to its NCES and Carnegie counterparts.

The superiority in terms of relative precision of the Carnegie 9 x 2 taxonomy to the NCHEMS 9 x 2 classification suggests that this level of classification should be reevaluated in the proposed taxonomy. It appears that the efficiency could be further improved by focusing on further splits in the four-year institutions rather than in the two-year schools. The concept of relative efficiency could again be used to determine when an optimum taxonomic structure had been developed.

If the proposed taxonomy were universally accepted by educational researchers and statistical organizations such as NCES, the benefits would be manyfold. As mentioned earlier, the reality of any taxonomy being universally adopted would improve the comparability and utility of most studies of postsecondary education. In addition, it is clear from the results of this study that national summary statistics published using the proposed taxonomy (rather than the current NCES 3 x 2 classification) would be considerably more useful to individual institutions since the categories are much more homogeneous. Finally, the acceptance of a standard classification would enhance the value of published statistics such as those found in tables 9-28 that can be used by researchers to develop highly efficient sampling designs and to generate generalized sampling variances.



* Includes first professional divinity as well as bachelor's,masters, and doctorate.
** Excludes two-year degrees.
*** Includes all health professional degrees.

Fig. 2: NCHEMS Category Computation Algorithm

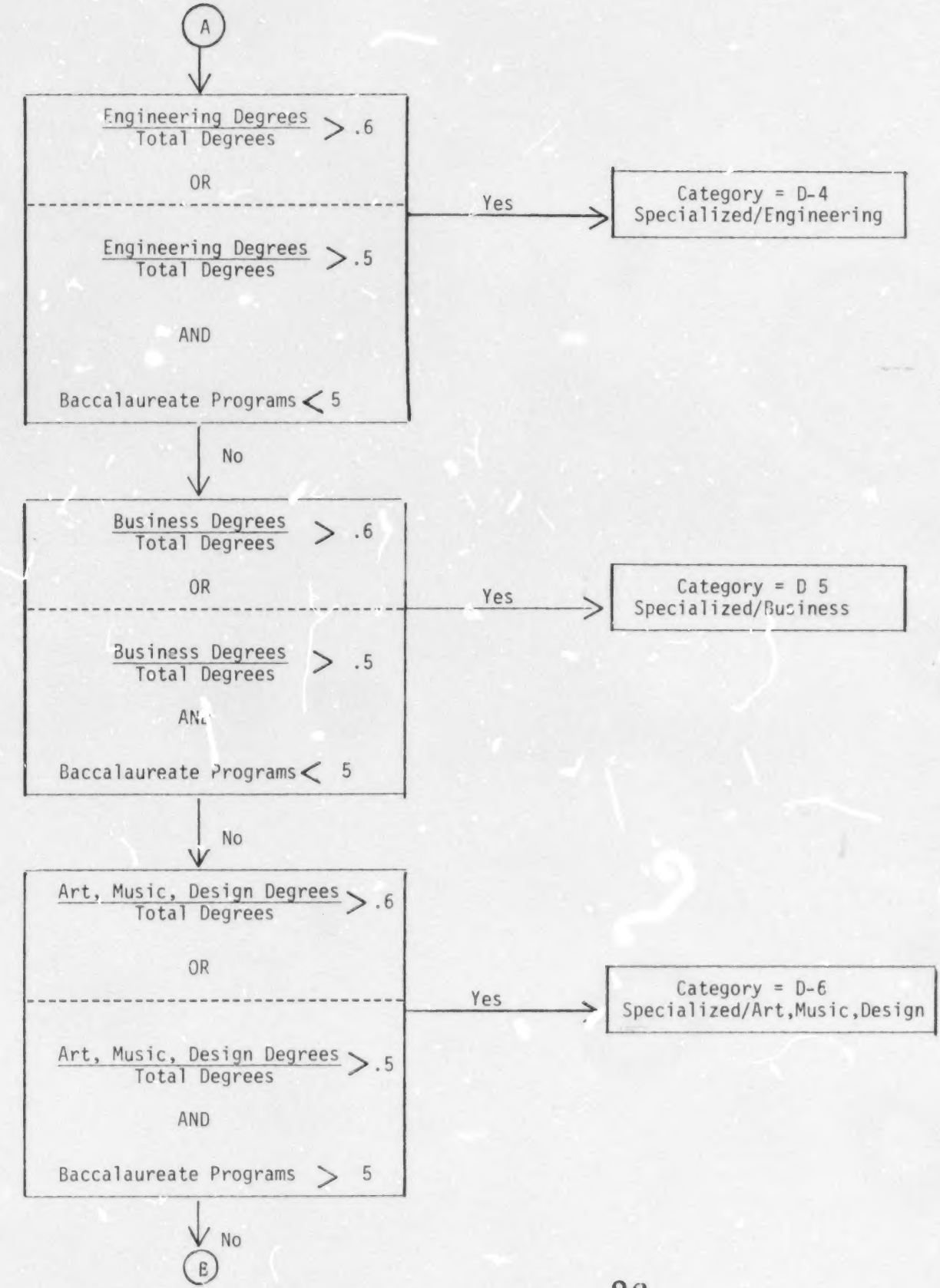


Fig. 2A: NCHEMS Category Computation Algorithm (continued)

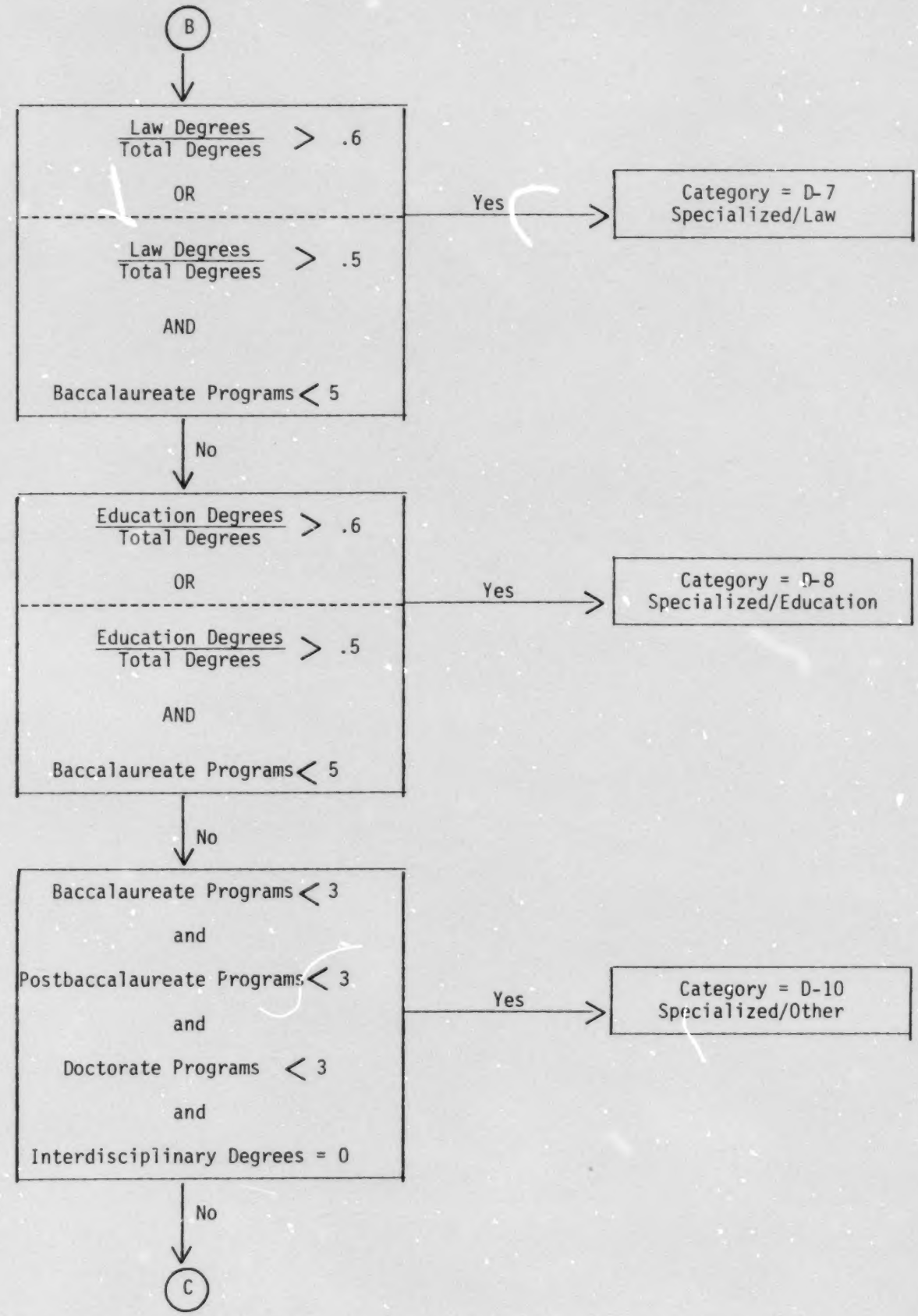


Fig. 2B: NCHEMS Category Computation Algorithm (continued)

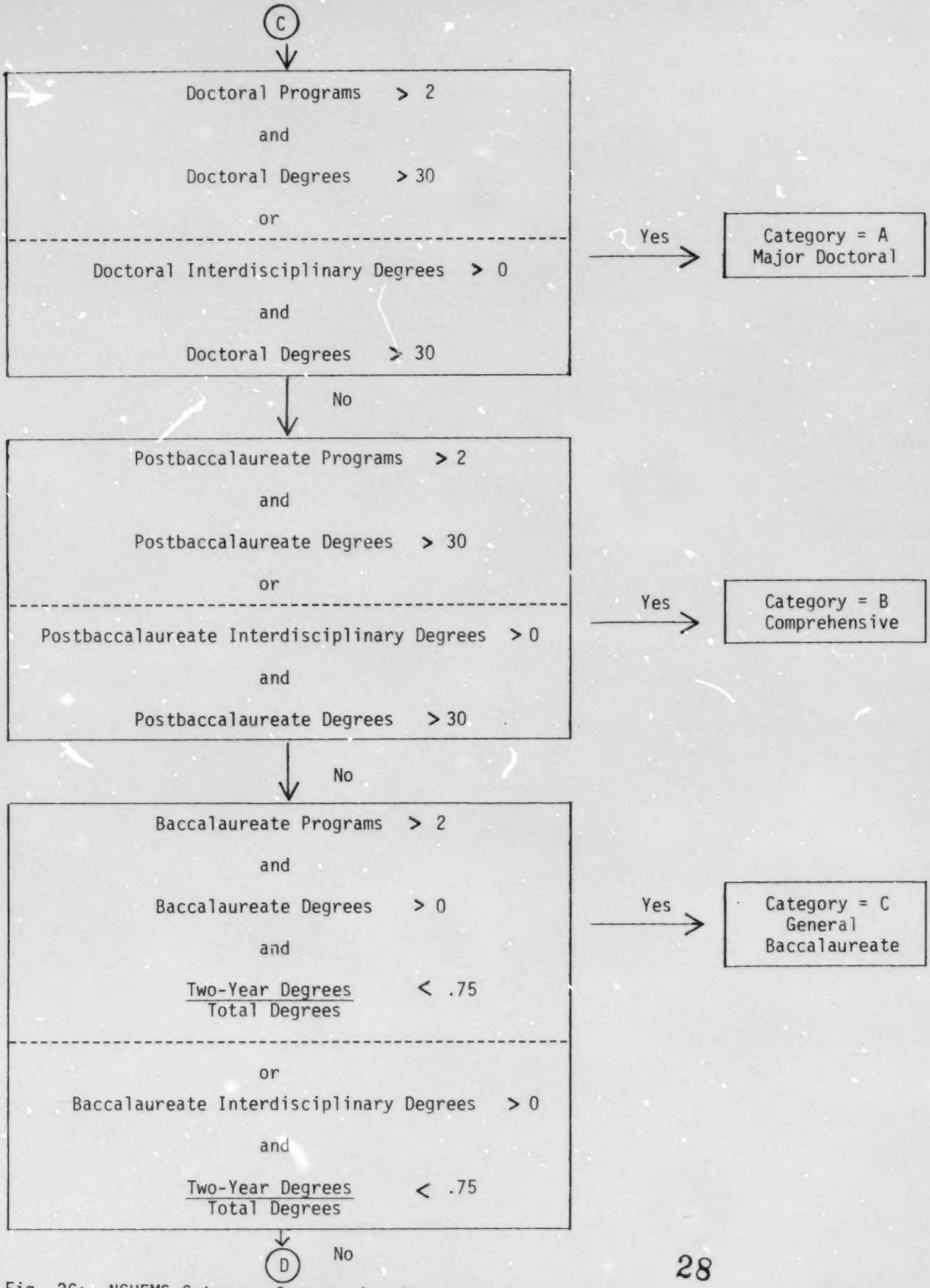


Fig. 2C: NCHEMS Category Computation Algorithm (continued)

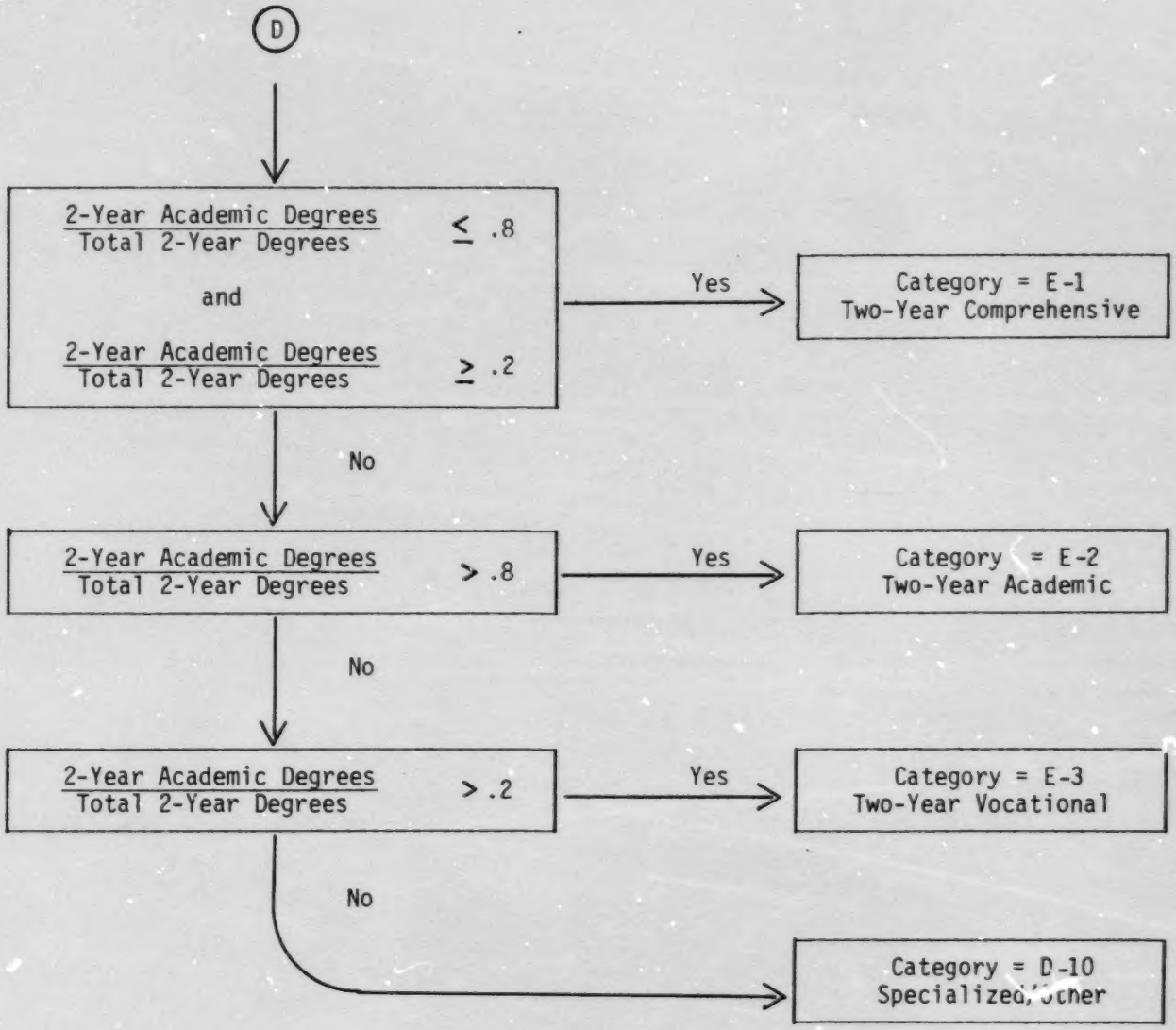


Fig. 2D: NCHEMS Category Computation Algorithm (continued)

Table 9

Total Degrees Awarded

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.1114 \times 10^5$	$.8969 \times 10^4$	$.2809 \times 10^4$	$.2102 \times 10^4$	$.2306 \times 10^4$	$.1940 \times 10^4$	$.1956 \times 10^4$
250	$.4230 \times 10^4$	$.3380 \times 10^4$	$.1027 \times 10^4$	$.7571 \times 10^3$	$.8302 \times 10^3$	$.6997 \times 10^3$	$.7059 \times 10^3$
500	$.1927 \times 10^4$	$.1516 \times 10^4$	$.4332 \times 10^3$	$.3086 \times 10^3$	$.3382 \times 10^3$	$.2864 \times 10^3$	$.2893 \times 10^3$
1000	$.7759 \times 10^3$	$.5846 \times 10^3$	$.1429 \times 10^3$	$.9439 \times 10^2$	$.1024 \times 10^3$	$.9031 \times 10^2$	$.9003 \times 10^2$

Table 10

Total Vocational Degrees Awarded (2-Year or Less)

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.4811 \times 10^3$	$.3348 \times 10^3$	$.2571 \times 10^3$	$.2364 \times 10^3$	$.2439 \times 10^3$	$.1997 \times 10^3$	$.2303 \times 10^3$
250	$.1827 \times 10^3$	$.1255 \times 10^3$	$.9564 \times 10^2$	$.8736 \times 10^2$	$.9036 \times 10^2$	$.7310 \times 10^2$	$.8493 \times 10^2$
500	$.8324 \times 10^2$	$.5579 \times 10^2$	$.4182 \times 10^2$	$.3770 \times 10^2$	$.3918 \times 10^2$	$.3091 \times 10^2$	$.3646 \times 10^2$
1000	$.3351 \times 10^2$	$.2091 \times 10^2$	$.1491 \times 10^2$	$.1287 \times 10^2$	$.1358 \times 10^2$	$.9883 \times 10^1$	$.1223 \times 10^2$

NOTE: Table entries in Tables 1-20 represent sampling variances.

Table 11

Total 2-Year Degrees Awarded

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.1099 \times 10^{4}$	$.6769 \times 10^{3}$	$.4862 \times 10^{3}$	$.4618 \times 10^{3}$	$.4665 \times 10^{3}$	$.4260 \times 10^{3}$	$.4511 \times 10^{3}$
250	$.4172 \times 10^{3}$	$.2519 \times 10^{3}$	$.1789 \times 10^{3}$	$.1693 \times 10^{3}$	$.1711 \times 10^{3}$	$.1554 \times 10^{3}$	$.1649 \times 10^{3}$
500	$.1901 \times 10^{3}$	$.1103 \times 10^{3}$	$.7651 \times 10^{2}$	$.7175 \times 10^{2}$	$.7258 \times 10^{2}$	$.6521 \times 10^{2}$	6950×10^{2}
1000	$.7654 \times 10^{2}$	$.3943 \times 10^{2}$	$.2530 \times 10^{2}$	$.2299 \times 10^{2}$	$.2334 \times 10^{2}$	$.2011 \times 10^{2}$	$.2180 \times 10^{2}$

25

Table 12

Number of Baccalaureate Programs

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.3986 \times 10^{0}$	$.4058 \times 10^{0}$	$.1000 \times 10^{0}$	$.3724 \times 10^{-1}$	$.3055 \times 10^{-1}$	$.3523 \times 10^{-1}$	$.2825 \times 10^{-1}$
250	$.1514 \times 10^{0}$	$.1541 \times 10^{0}$	$.3667 \times 10^{-1}$	$.1381 \times 10^{-1}$	$.1115 \times 10^{-1}$	$.1301 \times 10^{-1}$	$.1030 \times 10^{-1}$
500	$.6900 \times 10^{-1}$	$.7016 \times 10^{-1}$	$.1554 \times 10^{-1}$	$.5997 \times 10^{-2}$	$.4686 \times 10^{-2}$	$.5600 \times 10^{-2}$	$.4323 \times 10^{-2}$
1000	$.2859 \times 10^{-1}$	$.2820 \times 10^{-1}$	$.4984 \times 10^{-2}$	$.2092 \times 10^{-2}$	$.1454 \times 10^{-2}$	$.1896 \times 10^{-2}$	$.1333 \times 10^{-2}$

Table 13

Total Baccalaureate Degrees Awarded

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.4689 \times 10^4$	$.3573 \times 10^4$	$.5950 \times 10^3$	$.3939 \times 10^3$	$.4160 \times 10^3$	$.3556 \times 10^3$	$.3267 \times 10^3$
250	$.1781 \times 10^4$	$.1337 \times 10^4$	$.2029 \times 10^3$	$.1289 \times 10^3$	$.1341 \times 10^3$	$.1162 \times 10^3$	$.1044 \times 10^3$
500	$.8114 \times 10^3$	$.5922 \times 10^3$	$.7223 \times 10^2$	$.4093 \times 10^2$	$.4049 \times 10^2$	$.3741 \times 10^2$	$.3123 \times 10^2$
1000	$.3267 \times 10^3$	$.2196 \times 10^3$	$.1285 \times 10^2$	$.6647 \times 10^1$	$.4627 \times 10^1$	$.5610 \times 10^1$	$.3567 \times 10^1$

Table 14

Total Education Degrees Awarded (Baccalaureate and Above)

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.5663 \times 10^3$	$.4353 \times 10^3$	$.1092 \times 10^3$	$.6829 \times 10^2$	$.7405 \times 10^2$	$.6800 \times 10^2$	$.6908 \times 10^2$
250	$.2151 \times 10^3$	$.1633 \times 10^3$	$.3809 \times 10^2$	$.2288 \times 10^2$	$.2466 \times 10^2$	$.2275 \times 10^2$	$.2289 \times 10^2$
500	$.9798 \times 10^2$	$.7255 \times 10^2$	$.1439 \times 10^2$	$.7738 \times 10^1$	$.8201 \times 10^1$	$.7769 \times 10^1$	$.7498 \times 10^1$
1000	$.3945 \times 10^2$	$.2720 \times 10^2$	$.2702 \times 10^1$	$.1121 \times 10^1$	$.9540 \times 10^0$	$.1112 \times 10^1$	$.8648 \times 10^0$

Table 15

Number of Postbaccalaureate Programs

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.1929 \times 10^{0}$	$.1510 \times 10^{0}$	$.3307 \times 10^{-1}$	$.1081 \times 10^{-1}$	$.2306 \times 10^{-1}$	$.1062 \times 10^{-1}$	$.1868 \times 10^{-1}$
250	$.7326 \times 10^{-1}$	$.5715 \times 10^{-1}$	$.1198 \times 10^{-1}$	$.3781 \times 10^{-2}$	$.8188 \times 10^{-2}$	$.3720 \times 10^{-2}$	$.6716 \times 10^{-2}$
500	$.3338 \times 10^{-1}$	$.2586 \times 10^{-1}$	$.4946 \times 10^{-2}$	$.1438 \times 10^{-2}$	$.3232 \times 10^{-2}$	$.1420 \times 10^{-2}$	$.2662 \times 10^{-2}$
1000	$.1344 \times 10^{-1}$	$.1022 \times 10^{-1}$	$.1431 \times 10^{-2}$	$.2806 \times 10^{-3}$	$.7542 \times 10^{-3}$	$.2805 \times 10^{-3}$	$.6378 \times 10^{-3}$

27

Table 16

Total Postbaccalaureate Degrees Awarded

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.1585 \times 10^{4}$	$.1538 \times 10^{4}$	$.2694 \times 10^{3}$	$.1570 \times 10^{3}$	$.2165 \times 10^{3}$	$.1420 \times 10^{3}$	$.1704 \times 10^{3}$
250	$.6019 \times 10^{3}$	$.5833 \times 10^{3}$	$.9289 \times 10^{2}$	$.4953 \times 10^{2}$	$.7208 \times 10^{2}$	$.4503 \times 10^{2}$	$.5616 \times 10^{2}$
500	$.2742 \times 10^{3}$	$.2652 \times 10^{3}$	$.3405 \times 10^{2}$	$.1417 \times 10^{2}$	$.2395 \times 10^{2}$	$.1386 \times 10^{2}$	$.1867 \times 10^{2}$
1000	$.1104 \times 10^{3}$	$.1061 \times 10^{3}$	$.8328 \times 10^{1}$	$.2060 \times 10^{1}$	$.4862 \times 10^{1}$	$.2060 \times 10^{1}$	$.3738 \times 10^{1}$

Table 17

Total Baccalaureate Degrees as a Percent of Total Degrees Awarded

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.1615 \times 10^{2}$	$.1374 \times 10^{2}$	$.3429 \times 10^{1}$	$.1778 \times 10^{1}$	$.2050 \times 10^{1}$	$.1717 \times 10^{1}$	$.1938 \times 10^{1}$
250	$.6124 \times 10^{1}$	$.5210 \times 10^{1}$	$.1247 \times 10^{1}$	$.6410 \times 10^{0}$	$.7403 \times 10^{0}$	$.6168 \times 10^{0}$	$.6972 \times 10^{0}$
500	$.2782 \times 10^{1}$	$.2366 \times 10^{1}$	$.5196 \times 10^{0}$	$.2620 \times 10^{0}$	$.3039 \times 10^{0}$	$.2499 \times 10^{0}$	$.2836 \times 10^{0}$
1000	$.1111 \times 10^{1}$	$.9434 \times 10^{0}$	$.1558 \times 10^{0}$	$.7245 \times 10^{-1}$	$.8566 \times 10^{-1}$	$.6448 \times 10^{-1}$	$.7684 \times 10^{-1}$

28

Table 18

Total FTE Enrollment

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.1811 \times 10^{6}$	$.1298 \times 10^{6}$	$.4993 \times 10^{5}$	$.3929 \times 10^{5}$	$.4120 \times 10^{5}$	$.3621 \times 10^{5}$	$.3483 \times 10^{5}$
250	$.6879 \times 10^{5}$	$.4872 \times 10^{5}$	$.1838 \times 10^{5}$	$.1430 \times 10^{5}$	$.1495 \times 10^{5}$	$.1320 \times 10^{5}$	$.1267 \times 10^{5}$
500	$.3134 \times 10^{5}$	$.2168 \times 10^{5}$	$.7864 \times 10^{4}$	$.5973 \times 10^{4}$	$.6195 \times 10^{4}$	$.5526 \times 10^{4}$	$.5280 \times 10^{4}$
1000	$.1262 \times 10^{5}$	$.8161 \times 10^{4}$	$.2648 \times 10^{4}$	$.1885 \times 10^{4}$	$.1907 \times 10^{4}$	$.1770 \times 10^{4}$	$.1651 \times 10^{4}$

Table 19

Total Undergraduate FTE Enrollment

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.1148 \times 10^6$	$.7638 \times 10^5$	$.3655 \times 10^5$	$.2895 \times 10^5$	$.3016 \times 10^5$	$.2673 \times 10^5$	$.2625 \times 10^5$
250	$.4360 \times 10^5$	$.2857 \times 10^5$	$.1353 \times 10^5$	$.1062 \times 10^5$	$.1103 \times 10^5$	$.9796 \times 10^4$	$.9611 \times 10^4$
500	$.1987 \times 10^5$	$.1263 \times 10^5$	$.5863 \times 10^4$	$.4512 \times 10^4$	$.4659 \times 10^4$	$.4153 \times 10^4$	$.4065 \times 10^4$
1000	$.7998 \times 10^4$	$.4664 \times 10^4$	$.2031 \times 10^4$	$.1473 \times 10^4$	$.1490 \times 10^4$	$.1352 \times 10^4$	$.1303 \times 10^4$

29

Table 20

Total Graduate FTE Enrollment

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.4987 \times 10^4$	$.4664 \times 10^4$	$.6921 \times 10^3$	$.4202 \times 10^3$	$.5193 \times 10^3$	$.3512 \times 10^3$	$.3770 \times 10^3$
250	$.1894 \times 10^4$	$.1766 \times 10^4$	$.2283 \times 10^3$	$.1252 \times 10^3$	$.1611 \times 10^3$	$.1054 \times 10^3$	$.1153 \times 10^3$
500	$.8630 \times 10^3$	$.8000 \times 10^3$	$.7455 \times 10^2$	$.3220 \times 10^2$	$.4440 \times 10^2$	$.3119 \times 10^2$	$.3438 \times 10^2$
1000	$.3474 \times 10^3$	$.3170 \times 10^3$	$.1740 \times 10^2$	$.4958 \times 10^1$	$.7941 \times 10^1$	$.4957 \times 10^1$	$.5901 \times 10^1$

Table 21

Total Undergraduate FTE Enrollment as a Percent of Total FTE Enrollment

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.7460 \times 10^{1}$	$.6740 \times 10^{1}$	$.5709 \times 10^{1}$	$.3308 \times 10^{1}$	$.3289 \times 10^{1}$	$.3265 \times 10^{1}$	$.3228 \times 10^{1}$
250	$.2830 \times 10^{1}$	$.2550 \times 10^{1}$	$.2150 \times 10^{1}$	$.1229 \times 10^{1}$	$.1223 \times 10^{1}$	$.1212 \times 10^{1}$	$.1199 \times 10^{1}$
500	$.1290 \times 10^{1}$	$.1150 \times 10^{1}$	$.9642 \times 10^{0}$	$.5358 \times 10^{0}$	$.5337 \times 10^{0}$	$.5275 \times 10^{0}$	$.5224 \times 10^{0}$
1000	$.5200 \times 10^{0}$	$.4500 \times 10^{0}$	$.3711 \times 10^{0}$	$.1893 \times 10^{0}$	$.1893 \times 10^{0}$	$.1853 \times 10^{0}$	$.1842 \times 10^{0}$

30

Table 22

Total Full-Time Enrollment

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.1440 \times 10^{6}$	$.1057 \times 10^{6}$	$.3137 \times 10^{5}$	$.2441 \times 10^{5}$	$.2583 \times 10^{5}$	$.2232 \times 10^{5}$	$.2140 \times 10^{5}$
250	$.5468 \times 10^{5}$	$.3965 \times 10^{5}$	$.1146 \times 10^{5}$	$.8804 \times 10^{4}$	$.9281 \times 10^{4}$	$.8075 \times 10^{4}$	$.7736 \times 10^{4}$
500	$.2491 \times 10^{5}$	$.1763 \times 10^{5}$	$.4828 \times 10^{4}$	$.3602 \times 10^{4}$	$.3765 \times 10^{4}$	$.3327 \times 10^{4}$	$.3181 \times 10^{4}$
1000	$.1003 \times 10^{5}$	$.6624 \times 10^{4}$	$.1587 \times 10^{4}$	$.1117 \times 10^{4}$	$.1136 \times 10^{4}$	$.1050 \times 10^{4}$	$.9873 \times 10^{3}$

Table 23

Total Full-Time Faculty

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.4364 \times 10^3$	$.3368 \times 10^3$	$.8984 \times 10^2$	$.6767 \times 10^2$	$.7415 \times 10^2$	$.6111 \times 10^2$	$.5865 \times 10^2$
250	$.1657 \times 10^3$	$.1267 \times 10^3$	$.3275 \times 10^2$	$.2427 \times 10^2$	$.2656 \times 10^2$	$.2209 \times 10^2$	$.2111 \times 10^2$
500	$.7552 \times 10^2$	$.5666 \times 10^2$	$.1372 \times 10^2$	$.9803 \times 10^1$	$.1070 \times 10^2$	$.9085 \times 10^1$	$.8599 \times 10^1$
1000	$.3040 \times 10^2$	$.2165 \times 10^2$	$.4425 \times 10^1$	$.2924 \times 10^1$	$.3147 \times 10^1$	$.2828 \times 10^1$	$.2603 \times 10^1$

31

Table 24

Total Students to Total Full-Time Faculty Ratio

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.2580 \times 10^1$	$.2480 \times 10^1$	$.2059 \times 10^1$	$.1886 \times 10^1$	$.1816 \times 10^1$	$.1789 \times 10^1$	$.1770 \times 10^1$
250	$.9800 \times 10^0$	$.9400 \times 10^0$	$.7746 \times 10^0$	$.7058 \times 10^0$	$.6783 \times 10^0$	$.6680 \times 10^0$	$.6600 \times 10^0$
500	$.4400 \times 10^0$	$.4200 \times 10^0$	$.3464 \times 10^0$	$.3125 \times 10^0$	$.2990 \times 10^0$	$.2944 \times 10^0$	$.2900 \times 10^0$
1000	$.1800 \times 10^0$	$.1700 \times 10^0$	$.1323 \times 10^0$	$.1159 \times 10^0$	$.1093 \times 10^0$	$.1076 \times 10^0$	$.1049 \times 10^0$

Table 25

Total Expenditures for Research

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.3621 \times 10^{12}$	$.3528 \times 10^{12}$	$.5102 \times 10^{11}$	$.1745 \times 10^{11}$	$.1829 \times 10^{11}$	$.8670 \times 10^{10}$	$.9937 \times 10^{10}$
250	$.1375 \times 10^{12}$	$.1338 \times 10^{12}$	$.1577 \times 10^{11}$	$.2753 \times 10^{10}$	$.2977 \times 10^{10}$	$.1684 \times 10^{10}$	$.1594 \times 10^{10}$
500	$.6266 \times 10^{11}$	$.6085 \times 10^{11}$	$.4469 \times 10^{10}$	$.3810 \times 10^{9}$	$.3856 \times 10^{9}$	$.3592 \times 10^{9}$	$.3192 \times 10^{9}$
1000	$.2523 \times 10^{11}$	$.2435 \times 10^{11}$	$.8795 \times 10^{9}$	$.5310 \times 10^{8}$	$.7156 \times 10^{8}$	$.4671 \times 10^{8}$	$.5018 \times 10^{8}$

32

Table 26

Total Expenditures Per FTE Enrollment

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.3122 \times 10^{6}$	$.3085 \times 10^{6}$	$.2036 \times 10^{6}$	$.9040 \times 10^{5}$	$.7467 \times 10^{5}$	$.8799 \times 10^{5}$	$.7126 \times 10^{5}$
250	$.1186 \times 10^{6}$	$.1172 \times 10^{6}$	$.7553 \times 10^{5}$	$.3236 \times 10^{5}$	$.2611 \times 10^{5}$	$.3139 \times 10^{5}$	$.2482 \times 10^{5}$
500	$.5403 \times 10^{5}$	$.5336 \times 10^{5}$	$.3283 \times 10^{5}$	$.1301 \times 10^{5}$	$.9930 \times 10^{4}$	$.1252 \times 10^{5}$	$.9353 \times 10^{4}$
1000	$.2175 \times 10^{5}$	$.2146 \times 10^{5}$	$.1148 \times 10^{5}$	$.3797 \times 10^{4}$	$.2376 \times 10^{4}$	$.3545 \times 10^{4}$	$.2172 \times 10^{4}$

Table 27

Total Expenditures

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.6516 \times 10^{13}$	$.5930 \times 10^{13}$	$.1037 \times 10^{13}$	$.6903 \times 10^{12}$	$.7479 \times 10^{12}$	$.5345 \times 10^{12}$	$.5103 \times 10^{12}$
250	$.2475 \times 10^{13}$	$.2245 \times 10^{13}$	$.3545 \times 10^{12}$	$.2217 \times 10^{12}$	$.2420 \times 10^{12}$	$.1792 \times 10^{12}$	$.1662 \times 10^{12}$
500	$.1127 \times 10^{13}$	$.1016 \times 10^{13}$	$.1270 \times 10^{12}$	$.6826 \times 10^{11}$	$.7493 \times 10^{11}$	$.6427 \times 10^{11}$	$.5632 \times 10^{11}$
1000	$.4539 \times 10^{12}$	$.4018 \times 10^{12}$	$.3456 \times 10^{11}$	$.1738 \times 10^{11}$	$.1884 \times 10^{11}$	$.1767 \times 10^{11}$	$.1521 \times 10^{11}$

33

Table 28

Total Expenditures for Instruction

Sample Size	Univ	Control	NCES 3 x 2	NCHEMS 6 x 2	CARN 6 x 2	NCHEMS 9 x 2	CARN 9 x 2
100	$.9873 \times 10^{12}$	$.8662 \times 10^{12}$	$.1738 \times 10^{12}$	$.1256 \times 10^{12}$	$.1397 \times 10^{12}$	$.1057 \times 10^{12}$	$.1021 \times 10^{12}$
250	$.3750 \times 10^{12}$	$.3276 \times 10^{12}$	$.6046 \times 10^{11}$	$.4220 \times 10^{11}$	$.4730 \times 10^{11}$	$.3600 \times 10^{11}$	$.3449 \times 10^{11}$
500	$.1708 \times 10^{12}$	$.1480 \times 10^{12}$	$.2268 \times 10^{11}$	$.1442 \times 10^{11}$	$.1650 \times 10^{11}$	$.1315 \times 10^{11}$	$.1229 \times 10^{11}$
1000	$.6878 \times 10^{11}$	$.5821 \times 10^{11}$	$.6143 \times 10^{10}$	$.3686 \times 10^{10}$	$.4158 \times 10^{10}$	$.3537 \times 10^{10}$	$.3298 \times 10^{10}$

References

Carnegie Commission on Higher Education. A Classification of Institutions of Higher Education. Rev. ed. Berkeley, Calif.: Carnegie Commission on Higher Education, 1976.

_____. A Classification of Institutions of Higher Education. Berkeley, Calif.: Carnegie Commission on Higher Education, 1973.

Cochran, William G. Sampling Techniques. 2nd ed. New York: John Wiley and Sons, 1963.

Huff, Robert A., and Chandler, Marjorie O. A Taxonomy of Instructional Programs in Higher Education. Washington, D.C.: Government Printing Office, 1970.

53200107000400
150:882:WICHE:2BA350

National Center for Higher Education Management Systems
P.O. Drawer P, Boulder, Colorado 80302
An Affirmative Action/Equal Opportunity Employer